Spill Prevention, Planning, and Response

Nationwide, the safe shipment of oil and adequate preparedness to respond in the event of an oil spill are top priorities for both industry and government. Some oil facts:

- The United States consumes over 800 million gallons of oil per day, expected to increase to over 1 billion gallons per day by 2020.
- Over half of the oil consumed is imported, and most imports are carried by ship.

T/V Julie N, Portland , ME, November 1996

The Oil Pollution Act of 1990

The Oil Pollution Act of 1990 (OPA90) enacted by Congress after the *Exxon Valdez* oil spill in 1989, strengthened prevention, planning, response, and restoration efforts. Major provisions of OPA:

- Require vessel and facility owners that handle oil as cargo to develop plans detailing steps they will take to immediately respond to an oil spill. These plans must document agreements with oil spill cleanup organizations to respond in the event of an oil spill, be approved by the USCG or EPA, and be tested regularly.
- Require new oil carrying tank barges and tank ships operating in U.S. waters to have double hulls, and require existing tankers to be phased out of this service over a 25 year period, based on the age of the vessel.
- Subject spillers to unlimited liability for gross negligence, willful misconduct, violation of any federal operating or safety standard, failure to report a spill, or failure to participate in the cleanup.
- Establish a $1 billion Oil Spill Liability Trust Fund. The fund ensures that legal or monetary issues do not impede timely spill response or reimbursement for damages. Spillers are responsible for costs paid by the fund.
- Require the Coast Guard to study navigational measures to reduce spills.
- Allow states to pass stricter laws than OPA 90, which many have already done.

Spill Response

Black oil spewing from a large oil tanker is a powerful symbol of marine pollution and human impact on nature. Significant government and industry efforts are directed toward preventing oil spills and providing adequate response if prevention measures fail. During a spill, specific priorities and steps are taken to meet the challenges presented. For most spills the general goals are to:

- Ensure public and spill responder safety.
- Stabilize the source to stop additional oil discharge.
- Protect sensitive areas to limit the damage.
- Contain, collect, and recycle or dispose of oil.
- Rehabilitate wildlife.
- Implement cleanup strategies for impacted areas.

The response techniques employed in a spill are dependent upon the product spilled, quantity, location, response time, weather conditions, responder capability, and availability of response equipment. First response efforts are improved by pre-identifying resources at risk, protection priorities, available equipment, and response personnel so that the first response is initiated while incident specific priorities are determined This pre-spill planning is accomplished by Area Committees that consist of representatives from federal and state governments, with input from industry, academia, environmental groups, and the community. The Area Committees have written Area Contingency Plans that identify response resources, cleanup strategies, and resources at risk within their jurisdiction. These plans also identify the appropriate conditions for the various spill response techniques, including mechanical containment and recovery, dispersants and other chemical countermeasures, *in situ* burning, shoreline cleanup and natural removal. The optimal mixture of these response techniques will vary based on spill conditions.

Additional information is available from the sources and contacts listed on the opposite side of this sheet.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

Spill Prevention, Planning, and Response Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Spill Prevention, Planning & Response

- *Oil in the Sea*, National Academy Press, 1985
- U.S. Coast Guard Marine Safety and Environmental Protection Web site, **www.uscg.mil/hq/g-m/**
- EPA's Oil Program Web site, **www.epa.gov/oilspill/**
- *Oil Spill Intelligence Report's Oil Spill Basics: A Primer for Students*, **www.cutter.com/osir/primer.htm**
- NOAA HAZMAT Website, **response.restoration.noaa.gov**
- American Petroleum Institute Spill Prevention and Response Web page: **www.api.org/oilspills/**

Contacts for spill response planning

In the Coastal Zone, contact your local Coast Guard Marine Safety Office

- MSO Portland: 207-780-3251
- MSO Boston: 617-223-3000
- MSO Providence: 401-435-2300
- MSO Long Island Sound: 203-468-4444
- Activities New York: 718-354-4134
- MSO Philadelphia: 215-271-4870
- MSO Buffalo: 761-843-9570

In the Inland Zone, contact the Environmental Protection Agency Regional Office

- Region I (New England): 617-918-1260
- Region II (New York and New Jersey): 732-548-8730

Prevention of an oil spill is our best option to protect the environment. Federal, state, and local agencies work together with industry to reduce the risk of oil spills. At the Federal level, the U.S. Coast Guard provides services and oversight of commercial mariners to ensure safe commerce and environmental protection.

Drydock examinations are routine, comprehensive safety checks

Vessel and Facility Prevention

Federal, state, and local agencies regulate oil handling vessels and facilities. Regulations target vessel and facility construction, maintenance, and operations to reduce the threat of oil spills and other undesirable incidents. National procedural and mechanical requirements help maintain a standard of safety on vessels and at facilities. Vessels that fly the U.S. flag must pass regular Coast Guard inspections to keep the documents necessary to sail. However, 90% of U.S. commercial port calls are by vessels flying foreign flags. Foreign vessels are checked by the Coast Guard based on a risk ranking derived from flag state, classification society, owner, and vessel history. These targeted compliance checks reduce risks posed by foreign ships.

Land-based facilities can also be a source of oil discharges and are subject to regulation and periodic inspection by federal, state, and local agencies. Secondary containment is required at the tanks of such facilities to prevent the spread of spilled oil.

Prevention Through People

The USCG implemented a new strategic over-arching prevention program in 1996, Prevention Through People (PTP). The PTP program was created because most spills and most serious accidents are caused by human error. PTP emphasizes the role of people in preventing casualties and pollution.

Safety Initiatives

Recognizing that different segments of the maritime community have different needs, the USCG is working on various initiatives to minimize the potential of an oil spill as the result of maritime transport of petroleum. International efforts with Port State Control (the efforts of nations to reduce risks from foreign vessels) have enhanced the safety of deep draft vessels, including oil tankers. In July of 1998, the USCG began enforcing the International Safety Management (ISM) code for tankers. The USCG will not allow ships and companies into U.S. ports if they fail to meet ISM certification standards. For barges, the USCG will encourage the tank barge community to come into voluntary compliance with the American Waterways Operators' Responsible Carrier Program. Implementation of international and regional safety standards will help prevent maritime accidents and ocean oil spills.

Enforcement and Liability

Penalties from the enforcement of federal and state laws provide another incentive for the maritime community to comply with regulated standards, as sanctions range from letters of warning to criminal prosecution. The expanded limits of liability that apply to regulated vessels and facilities during an oil spill are completely removed if the spill was a result of gross negligence, willful misconduct, or a violation of federal safety, construction, or operating regulations.

Investigation, Continual Improvement

Even with the most effective prevention measures in place, accidents do occur. Investigations take place after a spill occurs to find the cause and identify ways to prevent future accidents. Results of investigation findings and recommendations may take several paths including legislative action, public involvement to encourage risk reduction, and regulatory changes.

Spill Planning and Preparedness

Because prevention efforts cannot eliminate all risks of transporting oil over water, facilities and vessels are required to plan for and conduct response actions if an accident occurs. Trained employees can use the plans and drills to their advantage to help minimize damages in the event of a spill.

Additional information is available from the sources and contacts listed on the opposite side of this sheet.

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Spill Prevention

- Tank Vessel Regulations, 46 CFR, Subchapter D, Parts 30–40
- Coast Guard's Marine Safety and Environmental Protection Web site, **www.uscg.mil/hq/g-m/**
- International Maritime Organization, Safety Conventions Web site, **http://www.imo.org/imo/convent/safety.htm**

Contacts for spill response planning

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- MSO Long Island Sound: 203-468-4464
- Activities New York: 718-354-4132

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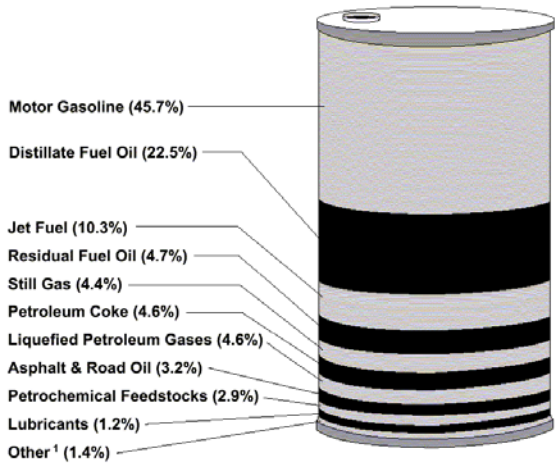
What is Oil?

Oil is necessary to run our cars, heat our homes, produce plastics and other materials, but it is damaging to the environment when spilled. Oil type is one of many factors influencing spilled oil behavior. Because oil type influences spill impacts and cleanup techniques, and because hundreds of petroleum product cross the oceans as cargo or fuel, oil identification is one of the first tasks in response. Oil is identified by the name of a crude oil field, by the kind of refined oil (such as jet fuel), or by more specific chemical analysis. Oils are also categorized into five generic density groups.

Oil Types:

Crude Oil: Crude (unrefined) oil is extracted from underground petroleum deposits formed from buried prehistoric organic material under pressure. The chemical composition of crude oil varies greatly from different regions of the world and even within a single formation, based on geologic history. Crude oils contain a range of "weights" of hydrocarbons, from light fractions similar to gasoline through heavy fractions made up of tars and waxes. While hydrocarbons make up 50-90% of crude oil, nitrogen, sulfur, and oxygen compounds as well as trace metals are also important.

Products from the refining of crude oil



[1] Includes kerosene, special naphthas, aviation gasoline, waxes, and miscellaneous products.
Note: Components do not add to 100 percent due to independent rounding and because of processing gain (an increase in volume that occurs during refining).

Refined Products: Crude oil is transported to and processed in refineries into hundreds of different substances. Several refining methods are used to separate different weight fractions and further process crude oil. End products are refined oils containing a narrower range of crude oil constituents (such as gasoline, jet fuel, and home heating oil), and other petrochemicals and feedstocks.

Five major oil groups and behaviors

Group I–Very Light (Jet Fuels, Gasoline)

- Highly volatile and flammable (evaporates quickly).
- High toxicity from soluble compounds.
- Toxicity causes localized, severe impacts to water column and intertidal resources.
- Resource recovery rate determines impact duration.
- Does not emulsify (water droplets in oil).
- Removal actions limited for safety and efficacy.

Group II–Light (Diesel, No. 2, Light Crudes)

- Up to ⅓ of Group II crudes will remain as residue.
- Moderate toxicity from soluble compounds.
- May cause long-term intertidal contamination.
- Has potential for subtidal impacts (dissolution, mixing, sorption to suspended sediments).
- Chemical dispersant not usually warranted.
- Can emulsify (water droplets in oil).

Group III–Medium (Most Crude Oils)

- About ⅓ will evaporate within 24 hours.
- May cause severe long-term intertidal impacts and severely impact bird and fur-bearing mammals.
- Chemical dispersion may be possible for 1-2 days.
- Can emulsify (water droplets in oil).
- Quick cleanup is most effective.

Group IV–Heavy (Heavy Crudes, No.6, Bunker C)

- Little to no evaporation or dissolution.
- Heavy impacts to intertidal areas and waterfowl and fur-bearing mammals (coating and ingestion).
- Long-term sediment contamination is possible.
- Weathers very slowly.
- Dispersion seldom effective.
- Can emulsify (water droplets in oil).
- Shoreline cleanup difficult under all conditions.

Group V–Very Heavy (Low API No. 6, Asphalt)

- Heavier than water – may float, have floating and sinking fractions, remain neutrally buoyant, or sink.
- No evaporation when submerged.
- Very viscous to semi-solid.
- Impacts from smothering, not toxicity.
- Weathers very slowly.
- Can emulsify (water droplets in oil).
- Subsurface cleanup technology limited

There is no such thing as a generic "oil spill", as oil types significantly influence spill response techniques. Understanding oil types is key to effective response.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

What is Oil?
Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Oil Types

- Oil in the Sea, National Academy Press, 1985
- Introduction to Coastal Habitats and Biological Resources for Oil Spill Response, NOAA / Hazmat, Introduction to Oil Spill Physical and Chemical Processes and Information Management, NOAA / Hazmat, **response.restoration.noaa.gov/oilaids.html**
- EPA's Oil Program Website, **www.epa.gov/oilspill/**
- National Response Team Web Site, **www.nrt.org**
- NOAA Hazardous Materials Response and Assessment Division, **response.restoration.noaa.gov**
- Oil Spill Intelligence Report's Oil Spill, Basics: A Primer for Students, **www.cutter.com/osir/primer.htm**
- Department of Energy's Energy Information Administration Web site: **www.eia.doe.gov**
- American Petroleum Institute Web site: **www.api.org**

Contacts for spill response planning

In the Coastal Zone, contact your local Coast Guard Marine Safety Office

- MSO Portland: 207-780-3251
- MSO Boston: 617-223-3000
- MSO Providence: 401-435-2300
- MSO Long Island Sound: 203-468-4444
- Activities New York: 718-354-4134
- MSO Philadelphia: 215-271-4870
- MSO Buffalo: 761-843-9570

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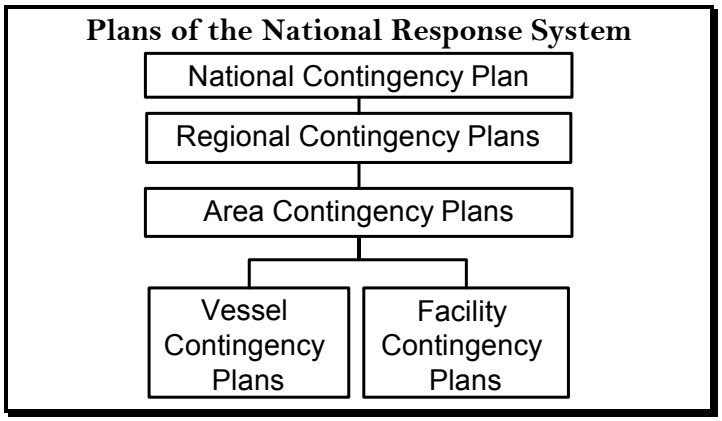
- Region I (New England): 617-918-1260
- Region II (New York and New Jersey): 732-548-8730

Oil Spill Response Plans

The National Response System ensures coordinated oil spill planning and response efforts by government and industry. Oil pollution cleanup under the National Response System is the responsibility of the polluter, so the System includes requirements to ensure facility and vessel response plans are in place.



National Response System Plans

National Oil and Hazardous Substances Pollution Contingency Plan:

Oil spill response planning in the United States is accomplished through a mandated set of inter-related plans. The National Oil and Hazardous Substances Pollution Contingency Plan, commonly referred to as the National Contingency Plan (NCP), provides the broad, national priorities and framework to ensure efficient, coordinated, and effective action to minimize the effects of oil and chemical spills. The NCP is published by the U.S. Environmental Protection Agency (EPA) in consultation with the National Response Team, which consists of 16 federal agencies with interests in various aspects of emergency response to pollution incidents. The NRT is chaired by the EPA and vice-chaired by the U. S. Coast Guard.

Regional Contingency Plans:

Ten Regional Contingency Plans, one of which applies to New England, are modeled after the NCP and add information specific to the region; these plans are written by Regional Response Teams (RRTs) whose membership mirrors that of the federal team, but includes all states and participating Indian tribes in the region.

Area Contingency Plans:

The next tier of plans is Area Contingency Plans (ACPs), which cover sub-regional geographic areas. The ACPs are a focal point of response planning, providing detailed information on response procedures, priorities, and appropriate countermeasures. ACPs are written by Area Committees assembled from government agencies with pollution responsibilities; non-governmental participants may attend meetings and provide input. The coastal and inland Area Committees are chaired by the individual (On-Scene Coordinator) from the Coast Guard and the EPA, respectively, who has the lead federal spill response authority for the planning area. Contacts for planning are listed on the opposite side of this sheet.

Industry Response Plans:

The final tier of plans under the National Response System umbrella for oil spill response are the Vessel Response Plans and Facility Response Plans required of facilities or vessels which handle oil as a cargo in sufficient quantity that could cause substantial harm to the environment if spilled. These plans detail pollution response actions for the specific vessel or facility, and must be submitted to the Coast Guard or the EPA for review or approval, depending on the threat posed to the environment.

Related Plans:

Several other plans exist that relate to the National Response System. Joint Contingency Plans are written with neighboring countries and apply in a transboundary spill. In a federal disaster, the National Response System supports the Federal Response Plan, which coordinates the larger federal disaster response.

Plan Testing and Improvement:

The plans of the National Response System are regularly exercised under the Preparedness for Response Exercise Program. This testing system, devised by the involved agencies, ensures that plans are current and that responsibilities assigned by the plan are tested and understood. Lessons learned from responses and drills are shared nationally, through both publications and an online database, to continually improve plans based on experience.

Additional information is available from the sources and contacts listed on the opposite side of this sheet.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

Oil Spill Response Plans
Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Oil Spill Response Plans

- National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, **www.epa.gov/oilspill/lawsregs.htm**
- Coastal Area Contingency Plans, available online and/or through NTIS, **www.uscg.mil/vrp/acpmenu.htm**
- National Response Team Website, **www.nrt.org**
- Preparedness for Response Exercise Program within the First Coast Guard District, **www.uscg.mil/d1/staff/m/prep/**

Contacts for spill response planning

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Oil Spill Response Roles

When prevention efforts fail and an oil spill occurs on the water, spill responders must quickly organize and establish incident-specific priorities to focus on the difficult task of cleaning up the spill. Pre-defined roles established by law and regulation and a planned use of the Incident Command System/Unified Command ensure that involved agencies and companies rapidly focus on cleaning up the spill.

Pre-incident understanding of roles and organization allows responders to quickly organize and focus on the incident.

Spill Roles and Responsibilities

Oil spill responses can involve a large number of organizations due to the potential for widespread and diverse impacts. Government agencies at several levels may have jurisdiction over different aspects of a spill response. To ensure effective coordination, lead agencies have been designated within the National Response System to coordinate or direct spill response efforts. While many spills are small and are cleaned up by the spiller under the supervision of local authorities, the National Response System ensures that state and federal resources are available to ensure adequate cleanup on larger or more complex spills. The following discussion focuses on spill responses that involve federal and state responders.

On-Scene Coordinator:

At the federal level, the On-Scene Coordinator (OSC), is an official from EPA for spills in the inland zone and from the Coast Guard for spills in the coastal zone. The OSC is the lead federal official for spill response. The OSC's responsibilities include coordinating all containment, removal, and disposal efforts and resources during an incident, including federal, state, local, and responsible party efforts.

State On-Scene Coordinator:

States' agencies also are key players in oil spill response. States have a position similar to the Federal OSC to coordinate or direct their spill response efforts. State regulations pertaining to response activities may exceed those of the federal government, as allowed by the Oil Pollution Act of 1990.

Responsible Party:

The spiller, or responsible party, has the primary responsibility to conduct spill cleanup, following the procedures listed in their vessel or facility response plan. The applicable plan provides for resources to respond to a worst case discharge from that vessel or facility. Industry is also required to have authorized and qualified individuals available 24 hours a day to respond to a spill, and to have sufficient funds available to cover the cost of pollution response to the limit of liability for the vessel or facility.

Unified Command:

The federal, state, and responsible party lead officials, because they share the goal of performing a rapid and effective spill cleanup, typically use the Incident Command System, a widely used management system in emergency response communities. During an oil spill, formation of a "Unified Command" is encouraged to direct spill response efforts, usually made up of the OSC, State OSC, and Responsible Party representative. Unified Command retains the underlying authorities of the federal and state officials, while allowing the unified leadership and creation of a joint incident action plan. Indian tribal officials, foreign officials, or local officials may have representatives in the Unified Command as appropriate for the specifics of an incident.

Supporting Teams and Special Forces:

In addition to defining the lead agencies in spill response, the National Response System also defines the roles of other agencies, such as those with trustee responsibility for natural resources, or those assigned to the National or Regional Response Teams to coordinate the support of those agencies' resources to an OSC during an incident. The NCP also establishes several special teams with specific capabilities to assist in spill response, including specially trained Strike Teams, a Public Information Assist Team, Scientific Support Coordinators, and an Environmental Response Team.

Additional information is available from the sources and contacts listed on the opposite side of this sheet.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

Oil Spill Response Roles
Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Oil Spill Response Roles

- National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, **www.epa.gov/oilspill/lawsregs.htm**
- National Response Team Website, **www.nrt.org**

Contacts for spill response planning

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Significant oil spills involve numerous agencies and hundreds, possibly thousands, of people conducting and supporting cleanup efforts. To promote effective and quick coordination during oil spill responses, the Coast Guard and the EPA use a management system called the Incident Command System (ICS), a part of the National Interagency Incident Management System (NIIMS). ICS provides a comprehensive framework for managing emergency and non-emergency events. Originally created to coordinate fire-fighting efforts at forest fires, it has been expanded to an all-hazard, all-risk management system. Many agencies and companies involved in emergency response have adopted ICS, resulting in improved coordination of response efforts.

Management Activities:

The ICS organization is built around five major management activities:

• *Incident Command* sets objectives and priorities and has overall responsibility at the incident. Safety, liaison, and information functions are assigned to command staff officers who report directly to the incident command.

• *Operations* conducts tactical operations to carry out an action plan, develops the tactical objectives and organization, and directs all resources.

• *Planning* develops the action plan to accomplish the objectives, collects and evaluates information, tracks resource status, and documents the response effort.

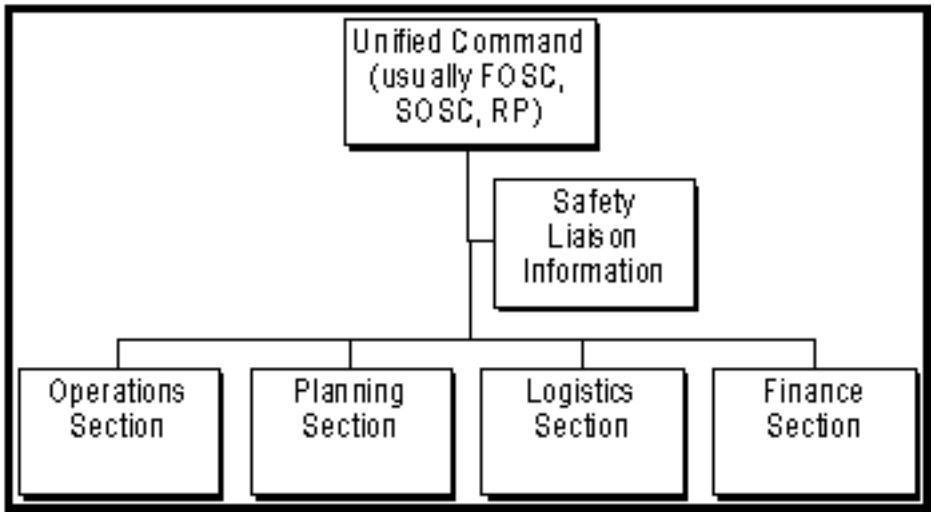
• *Logistics* provides support to meet incident needs, provides resources and all other services needed to support the incident response.

• *Finance/Administration* monitors costs related to the incident provides accounting, procurement, time recording, and cost analysis.

Flexibility:

The adaptability of ICS stems from the ability to expand or contract as necessary. One person, the Incident Commander, may manage small incidents. Large incidents require the functions of ICS to be set up as separate sections, which may be further subdivided. Span of control is maintained at three to seven employees per supervisor.

Unified Command:



In some incidents, including oil spills, there are several organizations that may have shared authority to respond. ICS has the advantage of combining efforts of the Responsible Party, multiple levels of government agencies, and assisting organizations into the same organizational system maximizing coordination and avoiding duplication of efforts. A structure called Unified Command allows the Incident Commander position to be shared among several agencies and organizations that have jurisdiction. In oil spills in the coastal zone, the Unified Command is typically comprised of the Federal On Scene Coordinator (FOSC), the State On Scene Coordinator(s) (SOSC), and a Responsible Party representative (RP). The spill situation may dictate other representation, such as Local or Tribal representatives, in the Unified Command. This group sets the overall incident objectives and guides and approves the incident action plan. The Unified Command members retain their authority, but work to resolve issues in a cooperative fashion so response efforts get maximum attention.

Planned Actions:

Every incident has an oral or written incident action plan prepared for each operational period, a period of time chosen based on the nature of the incident, typically a half day, a day, or several days.

Summary:

Originally developed to fight forest fires, ICS has grown into an incident management system that is widely adopted and used. Because of its flexible nature, low cost of implementation, and widespread use, it is an ideal system for emergency response.

Additional information is available from the sources and contacts listed on the opposite side of this sheet.

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about the Incident Command System

- Incident Command System National Training Curriculum: I-100 ICS Orientation, National Wildfire Coordinating Group, 1994. Available at **www.fema.gov/emi/is195.htm** or **www.uscg.mil/hq/cgi/ss/locc/part1.htm#ICSORI** (USCG course)

- Incident Command System Forms, U.S. Coast Guard Response Website, **www.uscg.mil/hq/g-m/nmc/response/Default.htm#Guide**

Contacts for spill response planning

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Effects of Oil in the Marine Environment

The environmental impacts of spilled oil can be severe. The damage caused by a spill depends on location, volume and type of oil spilled, weather conditions, season, and many other factors. Large spills cause widespread immediate impacts, and potential long-term damage to parts of affected ecosystems. However, chronic discharges such as from street runoff and improper oil disposal are also damaging. Cumulative chronic discharges far exceed major spills in volume. Cleanup operations remove some, but not all, oil from the environment; the oil that remains naturally degrades over time. Everyone can help reduce impacts of oil spills. Immediately report oil or chemical spills (800-424-8802), properly recycle used motor oil, carefully fuel cars or boats, promptly repair leaks, and take energy conservation steps. As a voter and consumer, your opinion is valued by your elected officials and companies you patronize.

Dead sea life after the January 1996 *North Cape* spill

Effects of Oil on Coastal Habitats

Coastal areas are particularly susceptible to oil pollution. When a large spill drifts ashore, some of the oil may become trapped and remain for years. This is in contrast to the open sea where currents and diffusion rapidly reduce the concentration of oil.

While shoreline impacts are very situation-specific, immediate effects of heavy oiling may be evident by the death of plants and animals due to smothering and toxicity. In some situations, oil may persist for many years, causing less apparent but harmful chronic effects.

In **rocky shore areas**, stranded oil may coat the rocks and gradually harden by weathering into a tough tarry "skin." This oil is gradually removed by wave erosion, but pools of oil that collect form a skin of weathered oil and may remain for a long time.

On **cobble and sandy beaches**, oil can sink more deeply into the sediments and can remain longer than on bare rocks. Tidal pumping and sediment grain size effect the rate of penetration. In muddy sediments, penetration is minimal.

Tidal flats are broad low-tide zones, usually containing rich plant, animal and bird communities. Oil may seep into the muddy bottoms and have long term impacts.

Salt Marshes have a wide variety of plant and animal species. Oiling of such systems may reduce the population and growth rate of the marsh plants and dependent species.

Effects of Oil on Marine Life

The two principal causes of harm to wildlife are toxicity and coating. Oil is most toxic during the initial phases of a release, before the lighter components have dissipated. These more toxic portions are also usually more soluble in water putting fish and shellfish at risk.

Birds: Birds are usually the most visible victims of an oil spill. Birds have a high likelihood of exposure, as they float on the water's surface with the oil. Oiled bird feathers no longer repel water, so oiled birds lose body heat rapidly, and may drown. Birds will also ingest any oil that adheres to their body through the activity of preening. This, combined with rapid loss of body heat due to loss of insulation may induce starvation. Oiled wildlife rehabilitation is possible, but survival rates vary based on the oil, species, time, and location. Usually only a fraction of oiled birds are captured for treatment.

Marine mammals: The most common marine mammals at risk in oil spills in U.S. waters are 13 species of seals and sea lions (several are endangered or threatened species). Effects include suffocation or respiratory damage by oil, loss of insulation, and poisoning. Most vulnerable are animals that have fur for insulation such as fur seals and sea otters.

Fish: Fish may be more resistant than other marine organisms to oil because their surfaces, including gills, are coated with oil repellent mucus, although larval fish, which may concentrate at the surface (with the oil) may be more vulnerable. Fish can be affected through the gills, by ingestion, or by eating oiled prey.

Shellfish: A good deal of study has been done on the effects of oil on shellfish, both bottom dwelling (lobsters, crabs, etc.) and intertidal (clams, oysters, etc.) Species living in bays, estuaries and other shallow environments are at particular risk because oil coming ashore may become concentrated. In addition to the toxic effects, heavy oils can literally smother and immobilize some invertebrate species. Sub-lethal effects are also seen, including changes in growth, metabolism, reproduction and behaviors.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

Effects of Oil in the Marine Environment Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Effects of Oil on the Environment

- *Oil in the Sea*, National Academy Press 1985
- *Introduction to Oil Spill Physical & Chemical Processes and Information Management*, NOAA / Hazmat
- *NOAA Hazardous Materials Response & Assessment Division Web site*, **response.restoration.noaa.gov/**
- *EPA's Oil Program Web site*, **www.epa.gov/oilspill/**
- *Oil Spill Intelligence Report's Oil Spill Basics: A Primer for Students*, **www.cutter.com/osir/primer.htm**
- *USCG's Marine Safety and Environmental Protection web site.*, **www.uscg.mil/hq/g-m/**
- *National Response Team*, **www.nrt.org/**
- Introduction to Coastal Habitats and Biological Resources for Oil Spill Response, **response.restoration.noaa.gov/oilaids.html**

Contacts for spill response planning

In the Coastal Zone, contact your local Coast Guard Marine Safety Office

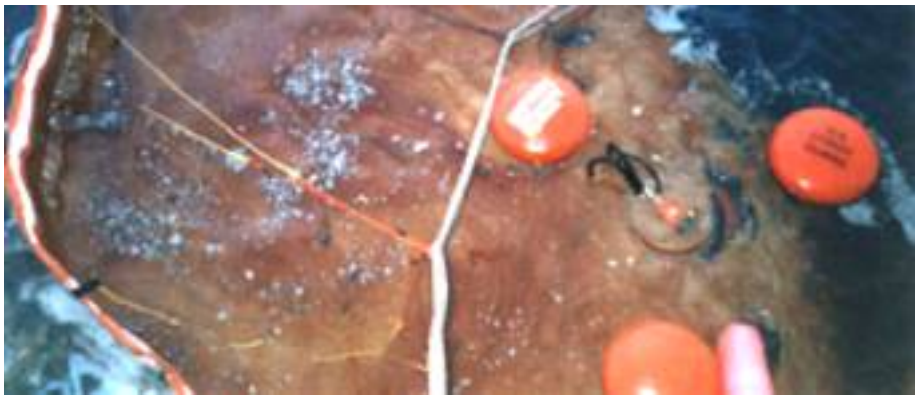
- MSO Portland: 207-780-3251
- MSO Boston: 617-223-3000
- MSO Providence: 401-435-2300
- MSO Long Island Sound: 203-468-4444
- Activities New York: 718-354-4134
- MSO Philadelphia: 215-271-4870
- MSO Buffalo: 761-843-9570

In the Inland Zone, contact the Environmental Protection Agency Regional Office

- Region I (New England): 617-918-1260
- Region II (New York and New Jersey): 732-548-8730

General Spill Response Considerations

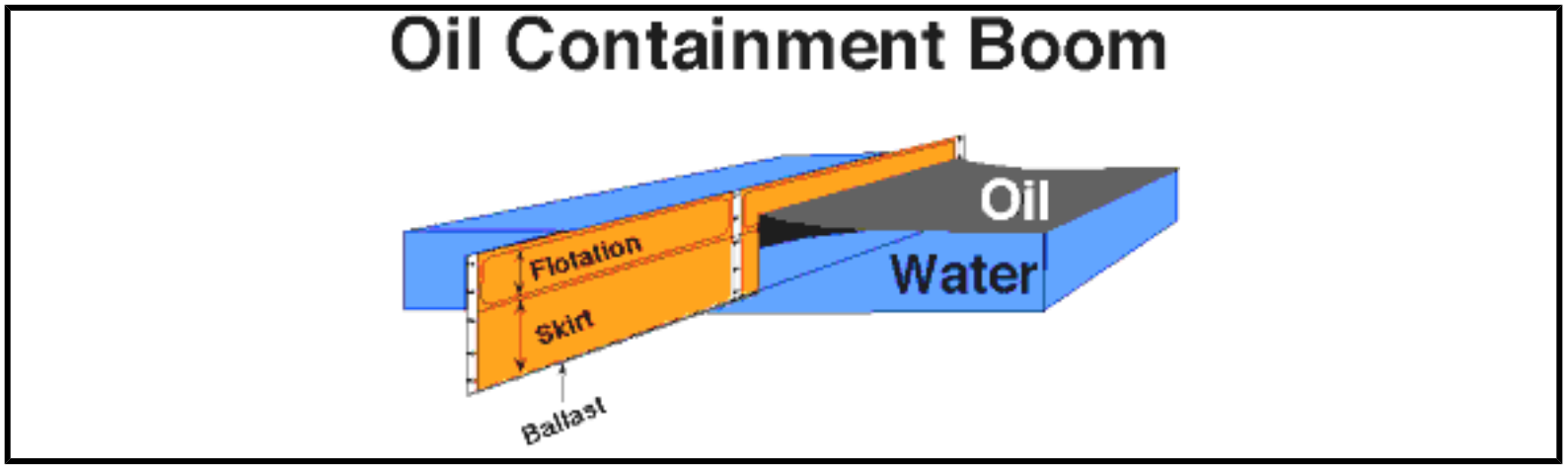
When prevention efforts fail and oil spills on the water, spill responders face a difficult battle against a dynamic and ever-changing opponent. Mechanical response methods, consisting of containment booms, skimmers, and other tools, is the most often used category of response techniques. Because of its limitations, it may be used in concert with non-mechanical methods including dispersants, *in situ* burning, natural removal, and shoreline cleanup.



A skimmer from the Coast Guard's Vessel of Opportunity Skimming System (VOSS) removes oil in its containment boom.

What Is Mechanical Spill Response?

Mechanical spill response uses physical barriers and mechanical devices to redirect and remove oil from the water's surface. Where feasible and effective, this technique is preferable to other methods, since spilled oil is removed from the environment to be recycled or disposed of properly. Mechanical removal of oil utilizes two types of equipment: booms and skimmers.

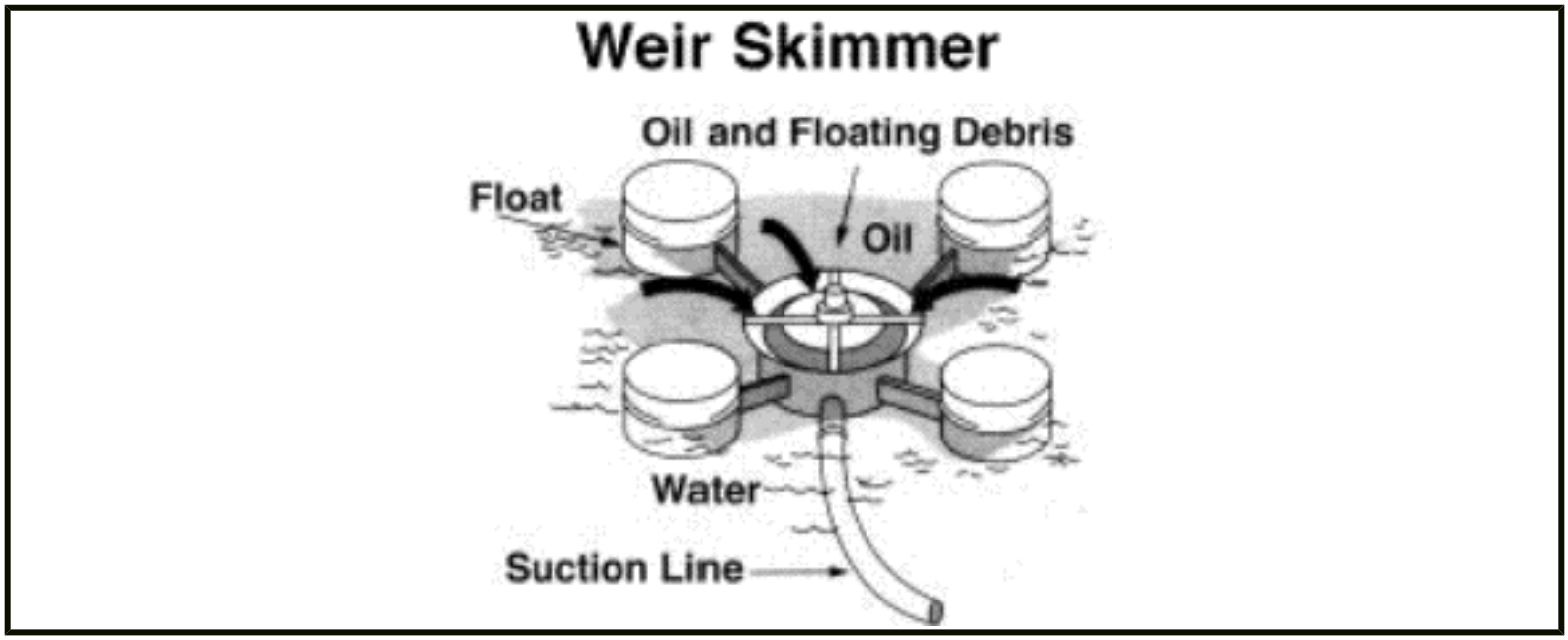


Oil containment boom allows water to pass below the boom skirt while stopping the oil floating on the water.

Oil Containment Booms: Spilled oil floating on the water's surface is affected by wind,

currents, and gravity, all of which cause it to spread. This oil may be concentrated or redirected by deploying floating barriers, called booms. Booms come in many different shapes, sizes, and styles. They are used for concentrating oil so that it is thick enough to be skimmed, for keeping oil out of sensitive areas, or for diverting oil into collection areas.

Just like the oil they are trying to corral, the success of booming is dependent on currents, wind, and waves. Even minor currents can draw oil under the booms; waves may cause splashover, and wind and currents may cause the boom to sink or plane.



A weir skimmer allows oil to spill over a weir at the oil/water interface, where it is then pumped into containment.

Skimmers: These devices remove oil from the water's surface and are typically used with booms that concentrate the oil to make it thick enough to be skimmed efficiently. The effectiveness of a skimmer is determined by how quickly it can collect the oil, and how well it minimizes water collected with the oil. Oil collected by the skimmer is stored in a containment tank. A wide variety of skimmers is available that use different methods for separating oil from water. Vessel-based skimming systems are utilized to remove oil from open water, while vacuum trucks are often used to remove oil that has collected near the shoreline.

What are the Potential Benefits?

- Physically removes oil from the environment.
- Allows recycling or proper disposal of recovered oil.

- Little direct environmental impacts in open water.

What are the Potential Tradeoffs?

- Wind, waves, and currents severely limit recovery.

- The advantages of actual oil removal from the environment must be weighed against the limitations of this method. By the time limitations become apparent, it may be too late to employ other countermeasures.

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Mechanical Containment & Recovery

- *Oil in the Sea*, National Academy Press 1985

- *Mechanical Protection Guidelines*, NOAA/HAZMAT and U.S. Coast Guard 1994, **response.restoration.noaa.gov/oilaids.html**

- *Response to Marine Oil Spills* ,The International Tanker Owners Pollution Federation, Ltd 1986

- EPA's Oil Program Web site, **www.epa.gov/oilspill/**

- Coast Guard's Marine Safety and Environmental Protection Web site, **www.uscg.mil/hq/g-m/**

- NOAA HAZMAT Website, **response.restoration.noaa.gov**

- Oil Spill Intelligence Report's Oil Spill Basics: A Primer for Students, **www.cutter.com/osir/primer.htm**

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Dispersants in Oil Spill Response

When prevention efforts fail and oil spills on the water, spill responders face a difficult battle against a dynamic and ever-changing opponent. Dispersant use is one of several tools that may be employed to minimize consequences of the spill. Only the Federal On-Scene Coordinator may approve dispersant use. Unauthorized use of dispersants or detergents on navigable waters is illegal.

A Coast Guard C-130 fitted with a modular dispersant system sprays water in a May 1997 exercise in Oregon

What Are Dispersants?

Dispersants are specially designed oil spill products that are composed of detergent-like surfactants in low toxicity solvents. Dispersants do not remove oil from the water, but instead break the oil slick into small droplets. These droplets disperse into the water and are further broken down by natural processes. Dispersion of oil into the water column occurs naturally in untreated spills; dispersants speed up this process. Dispersants also prevent the oil droplets from coming back together as another surface slick. Dispersed oil is less likely to stick to birds and other animals, shoreline rocks, and vegetation. The effects of the rapidly diluted dispersed oil must be weighted against the effects of that oil if it were allowed to impact the shoreline and wildlife.

Dispersants may be applied to oil from airplanes, helicopters, or vessels. Spray systems are designed to provide the correct droplet size and dosage, as both are important factors in effective oil dispersal. The volume of dispersant applied is a fraction of the volume of oil treated, with a typical dispersant to oil ratio of 1:20.

Where the Oil Goes

When the oil is treated with dispersants, it initially disperses within approximately the upper 30 feet of the water column. The dispersed oil will be spread horizontally by tides and currents, rapidly decreasing the concentration of the oil. Many impacted water column populations will rapidly recover from the dispersed oil exposure because of their mobility. If these impacts are expected to be short term, these organisms are given a lower priority than bird and mammal populations and sensitive shoreline habitats, which when oiled recover quite slowly. Typically, dispersant use is reserved for deeper waters to ensure sufficient dilution of the oil and to prevent impacts on bottom-dwelling organisms. There may be cases where use in shallower environments can be justified to minimize impact to highly sensitive areas that are difficult to otherwise protect. Like other spill response techniques, dispersants are not likely to be 100% effective, leaving a portion of the oil on the surface. Effectiveness will depend on the type of oil and environmental conditions.

Approval of Dispersant Use

Because of the tradeoffs involved (i.e., relative benefits and potential negative effects), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) restricts dispersant use. Dispersants must be on a national list maintained by the Environmental Protection Agency. Federal and state agency agreements establish areas where rapid decisions on dispersants may be made by the Federal On-Scene Coordinator. Use outside these areas requires the approval of additional agencies identified in the NCP.

Studies of Dispersants

Evidence from spills treated with dispersants show that dispersion of oil can reduce overall environmental impacts by reducing damage at the sea surface and shore. The limited damage from the 1993 *Braer* spill in Scotland was due to near total natural dispersion, and dispersant use on the 1996 *Sea Empress* spill in Wales reduced impacts and the intrusiveness, duration, and cost of the cleanup.

What Are the Potential Benefits?

- Reduces impact of oil on shorelines, sensitive habitats, birds, mammals, and other wildlife.
- Rapid treatment of large areas.
- Reduces oil storage and disposal problems.
- Accelerates natural degradation processes.
- Use in high seas and currents is feasible.

What Are the Potential Tradeoffs?

- Increased impacts on organisms in upper 30 feet of water column.
- Application may be restricted by equipment availability and time window for effective use.

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

Dispersants in Oil Spill Response Information and contacts

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Dispersants in Spill Response

- Using Oil Dispersants On The Sea, National Research Council, 1989
- The Use of Chemicals in Oil Spill Response, American Society of Testing and Materials, 1995

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General Spill Response Considerations

When prevention efforts fail and oil spills on the water, spill responders face a difficult battle against a dynamic and ever-changing opponent. *In situ* burning is one of several tools that may be employed to minimize consequences of the spill.

What Is In-Situ Burning?

In-situ burning means the controlled burning of oil "in place." On open water, burning requires specialized fire resistant boom because uncontained oil rapidly spreads too thin to sustain combustion. *In-situ* burning requires less labor than most other techniques and can be applied in areas where other methods can not be used because of limited access to the spill location or ice conditions. Fire-resistant booms are subject to some of the same wind and sea limitations as mechanical removal, since a fire boom behaves much like a standard containment boom. However, burning rapidly removes large quantities of oil and, minimizes the need for recovery and storage.

Newfoundland Offshore Burn Experiment, Canada 1993
Photo: David Evans, NIST

Where the Oil Goes

The primary products of in-situ burning of oil are carbon dioxide and water vapor. About 90% to 95% of the carbon product is released to the atmosphere as carbon dioxide, while particulates commonly account for about 5% to 10% of the original volume burned. About half of the particulates are soot, which is responsible for the black appearance of the smoke plume. Minor amounts of sulfur and nitrogen oxides and polyaromatic hydrocarbons are also emitted.

Field experiments have shown that most air pollutants of concern produced by an *in-situ* burn are concentrated around the area of the fire. Only one pollutant, the fine particles in the smoke, is of concern beyond the immediate area of the fire. Although these small particles from an *in-situ* burn will typically remain suspended and dilute high above the human breathing zone, monitoring plans have been established so responders can monitor particulate levels to ensure the protection of public health.

Effectiveness

During experiments and accidental burns of petroleum on water, *in-situ* burns have often removed over 90% of the contained oil. The small percentage of the original oil volume left unburned is typically a viscous, taffy-like material that floats for a long enough period of time to be manually removed.

Approval of In-Situ Burning

Because of the tradeoff decisions involved, certain approvals must be obtained prior to use of *in-situ* burning. Use of burning agents to increase oil combustibility is regulated by Subpart J of the National Contingency Plan. The State Implementation Plans required by the Clean Air Act are the primary plans that regulate air quality and pollutant sources. Agreements between state and federal regulatory authorities establish areas and necessary conditions where rapid decisions on *in-situ* burning may be made by the Federal On-Scene Coordinator and/or the State On-Scene Coordinator(s).

What Are the Potential Benefits?

- Reduces impact of oil on shorelines, sensitive habitats, birds, mammals, and other wildlife.
- Rapidly consumes oil in the burn.
- Reduces oil storage and disposal problems.
- Reduces the air quality impacts of the volatile hydrocarbons that would otherwise evaporate.
- The products of combustion are diluted in the air above and downwind of the burn, dispersing rapidly at ground level to normal concentrations.

What Are the Potential Tradeoffs?

- Air quality impacts limits use to certain locations and conditions to ensure protection of public health.

- Higher risks associated with sizeable fire.

- Application may be restricted by equipment availability and time window for effective use.

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about *In Situ* Burning in Spill Response

- *Burning Issues: Is torching the most benign way to clear oil at sea?* Science News 1993 144:220-223

- *In-Situ Burning of Oil: An alternative approach to spill response,* National Response Team, Research and Development Committee 1992

- *The Science, Technology, and Effects of Controlled Burning of Oil At Sea,* Buist, I.A., et al., Marine Spill Response Corporation Technical Report Series 94-013 1994

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As it is almost impossible to fully prevent shoreline oiling during a spill, cleanup decisions at the shoreline are as important as containment and protection priorities. Several factors influence the selection of cleanup techniques.

Spill response workers flush an oiled shoreline with water.

Influence oil volume and type

The type and quantity of the oil spilled must be determined. Oil types vary greatly and have a major influence on the degree of shoreline impact, oil persistence, and ease of cleanup. For example, lighter fuels (diesel, home heating fuel and light crude oils) will evaporate quickly, but tend to be more toxic and penetrate the shoreline sediments to a greater degree. Heavy oils (bunker C, #6 fuel and heavy crude oils) are less toxic to shoreline ecosystems and do not penetrate finer sediments, but they are very persistent, difficult to clean and may smother shoreline organisms.

Influence of Shoreline Type

Shorelines types greatly influence the impacts of oil and cleanup methods, and must be considered in each spill. State and federal mapping projects have categorized U.S. coastlines in terms of habitat sensitivity to oil. The NOAA Environmental Sensitivity Index, a widely used characterization scheme, ranks shorelines by sensitivity to oil spill impacts, predicted rates of removal of stranded oil by natural processes, and ease of cleanup.

The ESI shoreline ranks, from least to most sensitive:

1. Exposed rocky cliffs & seawalls
2. Wave cut rocky platforms
3. Fine to medium-grained sand beaches
4. Coarse-grained sand beaches
5. Mixed sand and gravel beaches
6. Gravel beaches/Riprap

7. Exposed tidal flats
8. Sheltered rocky shores/man-made structures
9. Sheltered tidal flats
10. Marshes

Defining Cleanup Options

Types of shorelines impacted and degree of impact allow responders to develop a list of preferred response options by shoreline type. Many Area Contingency Plans have pre-defined matrices with appropriate response methods by oil and shoreline type. Major categories of techniques include:

1) Natural Recovery
2) Manual Removal
3) Mechanical Removal
4) Passive Collection with Sorbents
5) Vacuum
6) Debris Removal
7) Sediment Reworking/Tilling
8) Vegetation Cutting/Removal
9) Flooding (deluge)
10) Ambient Water Washing (low to high pressure)
11) Warm Water Washing (< 90 °F)
12) Hot Water Washing (> 90 °F)
13) Slurry Sand Blasting
14) Solidifiers (special approval required)
15) Shoreline Cleaning Agents (special approval required)
16) Nutrient Enrichment (special approval required)

17) Burning (special approval required)

Preferred techniques for the spill are set based on shoreline type. For example, the method for treating exposed seawalls might be high-pressure, ambient-temperature seawater flushing at mid-tide stages. Natural recovery is often misunderstood; in sensitive environments active cleanup activity may cause more harm than allowing the oil to slowly degrade naturally, as disturbance by human cleanupactivity can drive oil below the surface causing significant damage.

Cleanup teams are mobilized based to conduct shoreline surveys and develop

recommendations for specific shorelines, based on the general options for each shoreline type. The survey teams include scientific and oil response expertise. Survey results include type, degree of oiling, location of specific sensitive resources to be avoided or protected, other logistical information, and the team's recommended cleanup method, selected from the agreed upon cleanup options for that shoreline type. Areas of specific concern are identified and are planned based on unique factors. Cleanup is monitored to ensure that continued response measures do not cause more harm than remaining oil.

Shoreline cleanup plans try to minimize the harm caused by spilled oil, not to clean up all oil. Responders must weigh the response priorities in determining the end point for shoreline cleanup actions.

In the event of a spill

- Contact the National Response Center at 800-424-8802

Suggested References about Shoreline Assessment & Cleanup

- Oil in the Sea, National Academy Press 1985

- *Shoreline Cleanup Assessment Manual,*
Shoreline Countermeasures for Temperate Coastal Environments, and
Introduction to Coastal Habitats and Biological Resources for Oil Spill Response,
response.restoration.noaa.gov/oilaids.html

- A Field Guide to Coastal Oil Spill Control and Clean-Up Techniques, CONCAWE 1987

- Environmental Effects and Effectiveness of In-Situ Burning in Wetlands LSU/NOAA

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